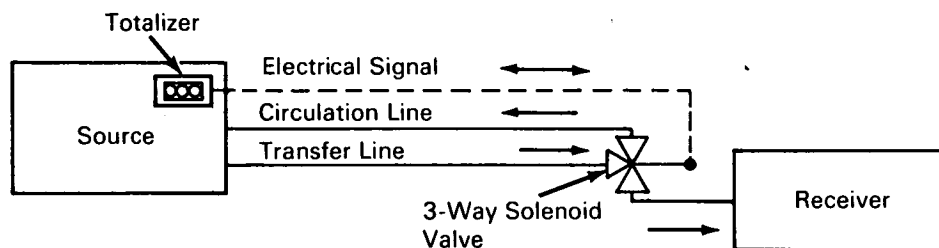


# NASA TECH BRIEF



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## Synchronized Circuit Improves Accuracy of Fluid Transfer Measurements



### The problem:

To improve the accuracy of measurements determining the quantity of liquid transferred from a storage tank or source to a remote location. Previous techniques measured the liquid leaving the source and did not accurately account for the residual fluid in the transfer line.

### The solution:

By using a shut-off valve at the destination of the transferred fluid, and synchronizing this valve with the measuring device (totalizer), the inaccuracies resulting from unfilled transfer lines can be reduced. The use of this technique requires that a circulation line be employed in the system in order to maintain the transfer line in a filled condition.

### How it's done:

The liquid is circulated from the receiver back to the source by means of the circulation line to establish a stabilized flow and a full transfer line. When fluid is to be transferred to the receiver, a valve diverts the flow from the circulation line and, at the same time, sends an electrical signal back to the quantity totalizer. The totalizer measures the volume of fluid entering the transfer line to replace the fluid being taken out. When the predetermined quantity has been transferred, the quantity totalizer stops and sends an electrical signal that closes the valve and again begins circulating the fluid.

A three-way solenoid valve is used at the receiver end of the transfer line. In one position it permits the fluid to return to the source through a circulation line. In the other position it permits the fluid to flow into the receiver. The solenoid valve and the totalizer operate in synchronization.

### Notes:

1. The error in measurement occurring during valve opening and closing is minimized by this technique. The totalizer begins functioning at the same time the valve starts to open. It stops functioning at the same instant that the valve begins to close. Since the quantity transferred during valve opening is approximately the same as the quantity transferred during valve closing, the potential errors between actual and measured quantities are effectively cancelled.
2. This information is complete in itself. It is presented here for its potential value in the application or adaptation to the reader's own needs.

### Patent status:

No patent action is contemplated by NASA.

Source: C. J. Vendl  
of North American Aviation, Inc.  
under contract to  
Manned Spacecraft Center  
(MSC-11167)  
Category 05

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Summary of the research results in this Technical Memorandum



The purpose of this research was to determine the effect of the various parameters on the performance of the system. The results show that the system is highly sensitive to the parameters, and that the performance can be improved by optimizing the parameters.

The results of the research are presented in the following sections. The first section describes the experimental setup and the parameters that were varied. The second section presents the results of the experiments, and the third section discusses the implications of the results.

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